K5 Slow down

Learn about:

- Parachutes
- Brakes

Stop!

This photo shows a drag racer. Drag racers have engines that give huge thrust, but no brakes. When they cross the finishing line they turn off the engine, but they only have air resistance to slow them down.

The parachute increases the air resistance because it 'catches' the air. The air particles hit the parachute, slowing the drag car down.

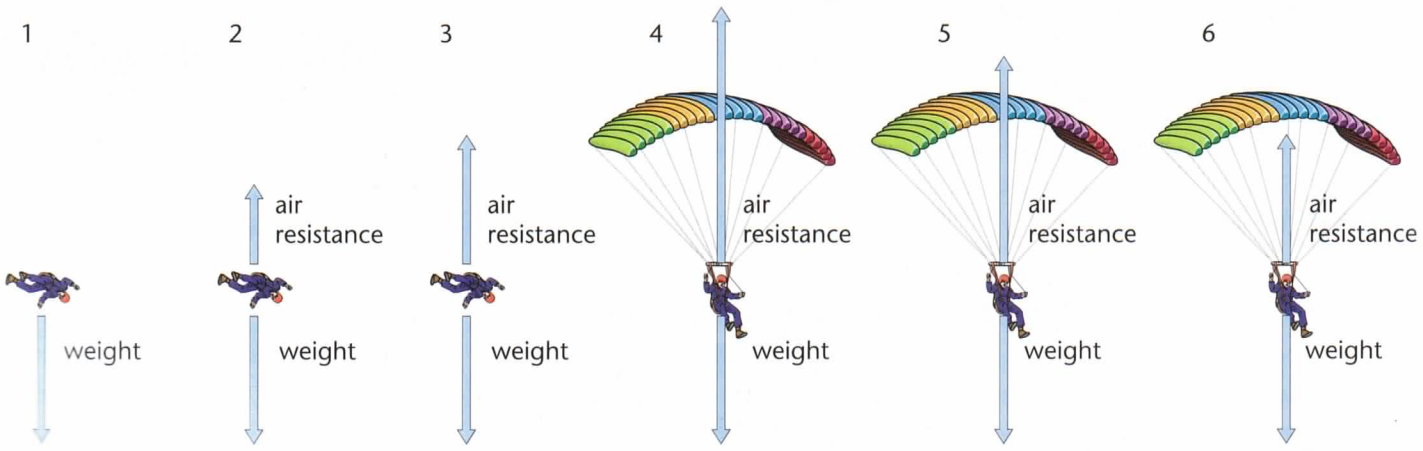
a **Why does a drag car racer want to minimise air resistance during the race but maximise it when the race is over?**

Falling

A skydiver (with equipment) has a mass of 100 kg. This means that her weight is 1000 N. The weight always acts downwards, towards the centre of the Earth. Air resistance acts upwards. That is because it is in the opposite direction to the movement, and she is falling.

The size of the air resistance depends on the speed of her fall and whether or not she has opened the parachute. The faster she is falling, the greater the air resistance, because she is pushing past more particles every second. An open parachute has a huge surface for the air particles to hit, increasing her air resistance dramatically.

	Event	Weight in N	Air resistance in N	Resultant force in N (up or down)	Accelerating, declerating or steady speed?
1	exits plane	1000	0	1000 down	accelerating
2		1000	600		
3	free fall	1000	1000		
4	parachute fully open	1000	2000		
5		1000	1600		
6	safe speed achieved	1000	1000		



The diagram at the bottom of page 106 show the forces for stages 1–6. The table gives the size of the weight and the air resistance on the skydiver at the same stages during her fall.

b **Copy and compete the table showing the resultant forces and movement of the skydiver. The first row is done for you.**

Putting on the brakes

Normal cars do not have parachutes to show them down! They have brakes. Brakes increase friction. Formula 1 racing cars have to slow down very quickly. The photo shows the car brakes glowing. If you rub your hands together, your palms get hot. The kinetic energy ends up as thermal energy. The same thing is happing in the car's brakes, only there is a lot more kinetic energy to be transferred.

Ships don't have brakes. They rely on the drag between the water and the ship to slow them down. This works better than it would with a car, because there is more friction between water and the sides of a ship than between air and the sides of a car. Big ships like oil tankers need a huge stopping distance – 20 miles or so!

The space shuttle also has no brakes. It uses the friction between itself and the atmosphere to slow it down on re-entry. Again, like the racing car, this generates a lot of thermal energy, raising the temperature of the surface to 3000°C. The heat shield on the outside of the shuttle insulates the astronauts.

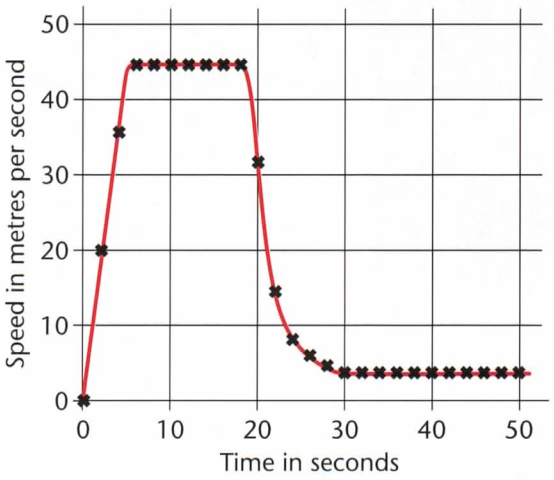
Did you know?

You can investigate how air resistance changes with speed now! Push the flat of your hand through the air. If you push slowly, you feel nothing. If you push fast, you feel the air that you are pushing out of the way.

c **A Formula 1 racing car has brake pads made of carbon. These brake pads 'vanish' during the race. Explain why.**

Questions

These questions refer to this speed–time graph, which shows a parachutist falling.



1 What is:

a the force upwards **b** the force downwards on the parachutist?

2 Between which times during the fall are these two forces equal? Explain how you made your decision.

3 Between which times during the fall is the parachutist:

a accelerating? **b** decelerating?

4 Explain why the parachutist has a larger air resistance with his parachute open than closed. Use the word 'particles' in your answer.

5 Explain why the air resistance is greatest just after the parachute opens, and then decreases as the parachutist slows down.

For your notes:

- Friction slows things down. Increasing friction can stop moving objects.
- Brakes use increased friction and parachutes use increased air resistance to slow things down.
- Parachutes have a large surface area for the air particles to hit.